

**Tamil Nadu Sustainably Harnessing Ocean Resources and Blue Economy  
(TN-SHORE) (with financial support from the World Bank)**

**Draft Environmental and Social Management Plan  
(ESMP) for the activity, “Protection, Consolidation, Eco-  
restoration and Conservation” under the sub-project  
Championing Pallikaranai: Advancing Wetland  
Conservation and Restoration**



**May ,2024**

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## **List of Acronyms**

### **ACRONYMS**

|          |                                                                    |
|----------|--------------------------------------------------------------------|
| BIS      | Bureau of Indian Standard                                          |
| BOCW     | Building and Other Construction Workers                            |
| CAPML    | Conservation Authority of Pallikaranai Marshland                   |
| ESDD     | Environmental and Social Due Diligence                             |
| ESMF     | Environmental and Social Management Framework                      |
| ESI      | Employees State Insurance                                          |
| ESMP     | Environmental and Social Management Plan                           |
| ESO      | Environment Safety Officer                                         |
| ESS      | Environmental and Social Standards                                 |
| E & S    | Environment and Social                                             |
| GBV      | Gender -Based Violence                                             |
| GoTN     | Government of Tamil Nadu                                           |
| GRM      | Grievance Redress Mechanism                                        |
| LMP      | Labour Management Plan                                             |
| OHS      | Occupational Health & Safety                                       |
| PF       | Provident Fund                                                     |
| PPE      | Personal Protection Equipment                                      |
| PIU      | Pollution Inspection Unit                                          |
| PUC      | Pollution Under Control                                            |
| SPMU     | State Project Management Unit                                      |
| TNGCC    | Tamil Nadu Green Climate Company                                   |
| TNPCB    | Tamil Nadu Pollution Control Board                                 |
| TN-SHORE | Tamil Nadu Sustainably Harnessing Ocean Resources and Blue Economy |

## **1.0. Project overview and description of sub-project**

### **1.1. Project Overview**

The Government of Tamil Nadu has launched a project entitled Tamil Nadu - Sustainably Harnessing Ocean Resources and Blue Economy (TN – SHORE) with funding from the World Bank. The project aims to enhance the resilience and sustainable utilization of coastal resources through a multi-pronged approach. It envisions a holistic integration of various sectors to drive a resilient and circular blue economy, empower local livelihoods, and enhance capacities for a greener future. To achieve these objectives, the project identifies five thematic prioritized investment areas. The project components are as follows:

Component 1: Strengthening Institutions for Integrated Coastal Management: This component focuses on strengthening institutional capabilities for comprehensive coastal zone management and governance.

Component 2: Shoreline management and coastal protection: Promoting coastal resilience through targeted investments in two key areas – 1) Erosion Control and Management and 2) Marine Biodiversity and Ecology Conservation.

Component 3: Improving livelihoods for natural resource dependent communities: This component focuses on supporting initiatives that foster alternative and sustainable livelihoods for coastal communities. Key activities include Nature tourism Development and Upgrading Fishing Harbors and Landing Centres.

Component 4: Reducing plastic waste and pollution through enhanced circularity: This component focuses on managing and reducing plastic waste in coastal and marine environments and promoting plastic circularity through an ecosystem-centered approach. Key activities include: Identifying Plastic Waste Hotspots, River System Investments and Digital Waste Exchange Platform.

Component 5: Project Management: This component is to cover the operational expenses of the project, which include: Procurement and Rental and Staffing.

Component 6: Contingency Emergency Response Component (Zero Budget)

### **1.2. Objective and Context of ESMP**

A project level ESMF has been prepared and disclosed. ESMF mandates that for all Low and Moderate Risk projects, a standard ESMP shall be prepared, which will be updated based on the sub project specific activities. Accordingly, Standard ESMP is prepared to describe the process to manage the impacts identified in the ESMF for the current activity (Refer Annexure 1 for ESMF details for the current two activities which are grouped under pre-construction activities). The ESMP also determines the implementation schedule, roles and responsibilities, reporting and monitoring requirements. The management plans included in this ESMP outline

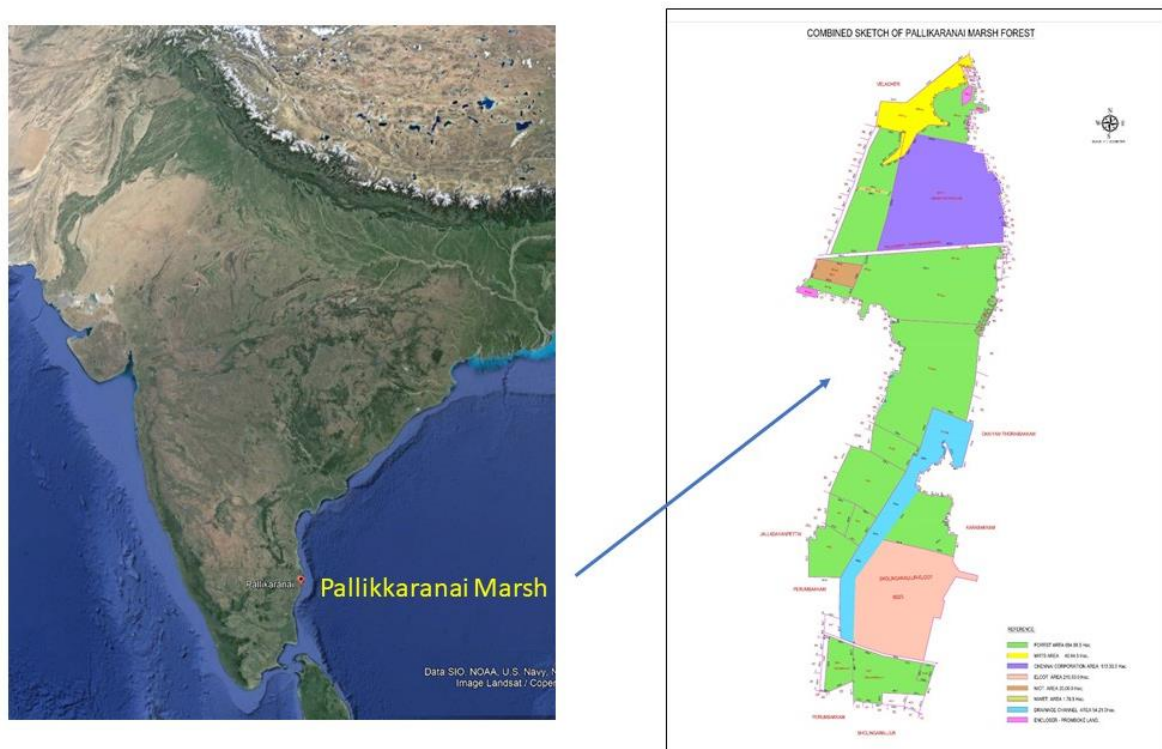
the environmental and social mitigation measures and management controls to be implemented in compliance with the E&S commitments.

Out of the activities planned, at present, the authorities have proposed to carry out two components namely i) Protection and Consolidation and ii) Eco-restoration and Conservation. As the activities are routine and minor in nature and have little impact on the environment and society, no ESDD has been prepared. Instead, a standard ESMP to deal with issues and appropriate mitigation measures to address the impacts as specified in the ESMF has been prepared. This will help CAPML to carry out mitigation measures suggested in the ESMP. The ESMP also determines the implementation stage, roles and responsibilities, reporting and monitoring requirements. The present ESMP is an indicative document and needs to be updated especially using the stakeholder views or new conditions that may arise in the field before commencing the sub-project activities. The CAPML is primarily responsible for the implementation of the ESMP.

### **1.3. Sub-Project Description**

The Pallikaranai Marsh, located in the southern part of Chennai city is one of the last remaining natural wetlands. It is locally known by the generic Tamil name 'kazhuveli' which means a flood plain or water logged area. On its eastern periphery, the Marsh is flanked by the Buckingham Canal and the Old Mahabalipuram Road, which houses the Information Technology (IT) Corridor. The southern and western boundaries are typified by mixed residential and institutional land use. To the North of the Marsh, there are dense human habitations and public infrastructure such as the Mass Rapid Transit System (Fig 1). Pallikaranai Marsh drains an area of 250 sq. km of South Chennai encompassing 65 wetlands through two outlets viz., Okkiyam Madavu and the Kovalam creek and drains into the Bay of Bengal. Though in the past the wetland had water all around the year, due to several impediments, part of it becomes dry during summer.

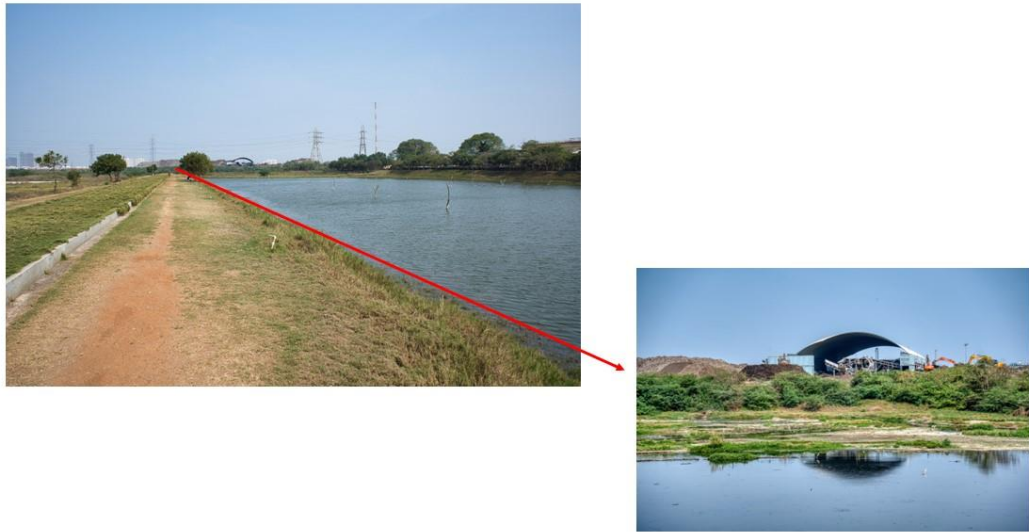
It is a home for native birds, rich in biodiversity and also visited in large numbers by the migratory birds. An area of 1247.54 ha has been designated a Ramsar site (April, 2022). The marshland over the years has degraded due to the conversion of a partial area of the marsh as a solid waste landfill and reclamation of the marsh for the establishment of institutions and commercial organizations. To prevent further degradation of the wetland, the marshland area of 700.47 Ha has been brought under the Administrative Control of Tamil Nadu Forest Dept. Out of this 530.07 ha (as of March, 2024) has been declared as a Reserved Forest. (Fig 1)



**Fig 1. Location of Pallikaranai Marsh and Land use and Land cover of the marsh**

The major problems prevailing in Pallikaranai Marsh have been identified as:

- The marsh is affected by organic waste disposal and contamination as is indicated by the high levels of chloride and sulphate. The stagnancy of surface water in marshlands of dumping yards for long periods because of its low elevation, long drainage path, and extremely low hydraulic gradients. A photo of the garbage dump is placed below (Fig 2).



**Fig.2. Photos showing the Location of the dump yard inside the Pallikaranai Marsh and a close view (Photo 13 March 2024)**

- Site roads are developed on compacted waste and during periods of wet weather they are prone to a loss of bearing capacity as a result of water logging or flooding. Waste was dumped directly into the water and became submerged during periods of elevated water levels.
- Water drainage, pollution, excessive use, and invasive species are all putting wetlands in danger. A prominent canal carrying untreated sewage from the northern areas like Madipakkam and Alandur was noted during the recent field visit (Fig.3). During the rainy season, rainwater mixed with untreated sewage also flows from these areas into the marsh



**Fig.3. Channel from northern settlements carrying sewage to the marsh  
(Photo 13 March 2024)**

- Urbanization: The marsh land is occupied by institutional and commercial buildings, residences and the dump yard. A view of commercial buildings on the southern side (Shollinganallur) can be seen in Fig 4.



**4. Far view of commercial establishments inside the southern side of the marsh with a water channel flowing towards south (Photo 13 March 2024)**

- Invasive species: Indian wetlands are threatened by exotic introduced plant species such as water hyacinth and salvinia. They clog waterways and compete with native vegetation. A view of the water hyacinth present in the northern part of the marsh is shown in Fig 5.



**Fig.5 Water hyacinth growth in the north-central part of the Marsh (Photo 13 March 2024)**

- Changes in Habitat topography: Obstruction of water flow from the marsh towards the Bay of Bengal through Okkiyam Madavu and Buckingham Canal, has led to changes in the elevation profile of the marsh which is evident from the total dryness of a few areas with a lack of vegetation and water stagnation in others. One such area on the northern side of the marsh is shown in Fig 6.



**Fig.6. Topographic changes inside marsh showing dry areas without vegetation (Photo 13 March 2024)**

The proposed sub-project has sub-components. These are: i) Updation of the Comprehensive Management Plan, (ii) Protection & Consolidation, (iii) Eco-Restoration & Conservation iv) Monitoring Bird diversity, and v) Eco-tourism and Eco-development (including Establishment of a Conservation Centre). As a priority, currently, only the activities relating to (ii) Protection & Consolidation, and (iii) Eco-Restoration and Conservation will be taken up for the present ESMP. **These are the pre-construction activities of the Conservation centre.** The other activities will be carried out separately and they are not under the purview of the current ESMP.

#### **1.4. Proposed Interventions/activities and intended outcomes**

The interventions proposed to achieve the restoration of the ecological conditions of the marsh are:

##### **1.4.1 . Protection and Consolidation**

###### **a. Systematic Survey & Demarcation of Boundaries Activities**

- Survey of Pallikaranai Marshland -
- Drone Mapping to clearly demarcate the boundary
- Installation of boundary stones

###### **b. Removal of Impediments Activities**

- Removal of Impediments such as debris, Solid wastes etc.

###### **c. Enhanced Access to Marshland Activities**

- Bund Formation using materials removed during the clearing of waterways & Consolidation by plantation
- Construction of small bridges across waterways in the Marshland
- Construction of Entrance Arch & Gates at two places for enhanced access

##### **1.4.2. Eco-Restoration & Conservation**

###### **Structural Measures**

- Removal of debris and de-silting of channels
- Desilting of existing Culverts:

###### **Bioremediation Measures Activity**

- Phytoremediation Activities

*Removal of Eichhornia, Hydrology and water quality monitoring, Diverting the inflow water, Construction of Sludge stabilization ponds and creation of constructed wetlands*

###### **Removal of Aquatic & Terrestrial Weeds Activities:**

- Removal of Aquatic Weed
- Removal of Terrestrial Weed
- Removal of overgrown aquatic weeds

###### **Establishing Green Belt Activities:**

- Establishing Green belt by native species plantations

#### Habitat Enrichment

- Managing wetland fauna-habitat enrichment
- Monitoring the bird diversity, and population by monthly census

More details on the above aspects are given in Annexure 2.

### 1.5. Environmental and Social Issues identified in ESMF and ESS applicability

The ESMF prepared for project component activities has identified issues like Waste generation due to the removal of weeds, silt, debris, Prosopis, etc and the labour is exposed to risk of injuries and exposure to contamination and pollution. Disposal of waste is also an issue. The ESMF has categorised the risks as low to substantial (Annexure 1). The activity on clearing of blockages which involves removal silt has been categorised as Substantial risk. Though no specific reason has been given for assigning substantial it is presumed that the silt may contain toxic substances which may be harmful to human. The applicability of ESS standards to the likely environmental and social issues and impacts that may arise due to the proposed activities has been analysed and given in Table 1.1.

**Table 1.1: ESS Applicability Analysis**

| ESS                                                                                     | Activities triggering ESS                                                                                                                                                                                                                                                           | Applicability |
|-----------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| ESS1: Assessment and Management of Environmental and Social Risks and Impacts           | Waste generation due to the removal of weeds, debris, silt, Prosopis, etc., Gender involvement in the works and issues on Occupational Health and Safety likely to occur                                                                                                            | Applicable    |
| ESS2: Labour and Working Conditions                                                     | Labour involvement in the removal of weeds, clearing of debris, transport etc. Use of silts for bund strengthening also results exposure to bacteria and harmful substances present in the silt. Occupational Health and Safety issues, Possibility of Gender Based issues like GBV | Applicable    |
| ESS3: Resource Efficiency, Pollution Prevention and Management                          | Temporary dumping of removed aquatic weeds, resulting in solid waste and groundwater pollution till disposed of. Non-point sources of sewage disposal from settlements around the marsh                                                                                             | Applicable    |
| ESS 6: Biodiversity conservation and Sustainable Management of Living Natural resources | Removal of Prosopis may affect bird habitats till the plantations made on bunds are established. Dredging of silt may temporarily affect aquatic fauna living in sediments                                                                                                          | Applicable    |

| ESS                                                       | Activities triggering ESS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Applicability |
|-----------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| ESS 10: Stakeholder Engagement and Information Disclosure | The local settlements around the marsh and local body are the stakeholders. It is proposed to create awareness in the community about the benefits of marsh restoration activities and also the essentiality of keeping the marshland free from non-point sources of sewage pollution. Municipal authorities to ensure stoppage of sewage flow from Madipakkam and Alandur areas into the canal leading to the marsh. Also to ensure the same in southern parts of the marsh. Awareness creation is already included as one of the project activities. Disclosure of the progress made under the project activities will have to be made through the website and also in Stakeholder meetings at the project locations. | Applicable    |

## 2.0 . Environmental and Social issues, relevant ESS categories and Mitigation and Monitoring Plan

### 2.1. Purpose of E & S Mitigation and Monitoring

Table 2.1 provides details on activities, issues resulting out of the actions, mitigation measures, and a monitoring plan

**Table 2.1. Standard Environmental and Social Management Plan (ESMP) for Protection, Consolidation, Eco-restoration and Conservation of Marshland and Biodiversity**

| Sr. No. | Activity and Environmental aspects                                                                                                                                                                                                                                                                                                                                                                                                                               | Potential Environmental and Social impacts                                                                                                                                                                                                                                                                                                                                                                                          | Mitigation Measures and/or Safeguards                                                                                                                                                                                                                                                                                                                                                        | Responsibilities       |                                                                                       |
|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------------------------------------------------------------------|
|         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                              | Planning and Execution | Supervision/ Monitoring                                                               |
| A       | <b>Pre-construction activity</b>                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                              |                        |                                                                                       |
| 1       | <p>Removal of debris and de-silting of channels to reduce the depth from 0.5 to 2.5m below the Chart datum to facilitate free flow of water from the southern part of the 200-foot road to the northern part. Removal of debris and de-silting to be done using machines.</p> <p>Removed debris and silt to be used for construction/strengthening of bunds. Formation of bunds and levelling made using machines.</p> <p>ESS 1, ESS 2, ESS 3, ESS 6, ESS 10</p> | <p>Removed debris and dredged materials like silt may contain toxic elements and bacteria. Possible infection to workers. Dust generation due to the use of machinery for bund construction.</p> <p>The possibility of Gender Based Violence (GBV) in the workforce involves women also. The stakeholders whose residences are around the periphery of the marsh are also exposed to odour due to removal of contaminated silt.</p> | <p>Safety measures prescribed while operating machines should be followed. Spray of water to prevent dust in the surrounding atmosphere.</p> <p>Protective gear like gloves to avoid contact with contaminated debris and silt.</p> <p>Training and awareness of workers on handling of debris, to prevent GBV incidences and establishment of Grievances and Redressal Mechanisms (GRM)</p> | Contractor             | Conservation Authority of Pallikaranai Marshland (CAPML) Tamil nadu Forest Department |

| Sr. No. | Activity and Environmental aspects                                                                             | Potential Environmental and Social impacts                                                                                                                                                           | Mitigation Measures and/or Safeguards                                                                                                                                                                                                                                                                | Responsibilities       |                         |
|---------|----------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-------------------------|
|         |                                                                                                                |                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                      | Planning and Execution | Supervision/ Monitoring |
| 2       | Consolidation of the bunds by raising plantations with taller size indigenous tree species<br><br>ESS 2        | Chances of injury to human involved in operation of machines, OHS and GBV                                                                                                                            | Safety measures prescribed while operating machines should be followed. Training and awareness of workers, to prevent GBV incidences and establishment of Grievances and Redressal Mechanism (GRM)                                                                                                   | Contractor             | CAPML                   |
| 3       | Removal of Eichhornia plants in the entry point of the channel by deploying floating machinery<br>ESS 2, ESS 3 | Chances of contamination at disposal site by chemicals absorbed by Eichhornia and also presence of harmful may affect human involved in removal. Occupational Health and Safety (OHS) and GBV issues | The removed Eichhornia plants must be disposed of safely without causing pollution in another area. In case of use of any labour for this activity, suitable protective gear should be provided to avoid human contact, as the bacteria present in the plant may pose health risks to the labourers. | Contractor             | CAPML                   |

| Sr. No. | Activity and Environmental aspects                                                                                           | Potential Environmental and Social impacts                                                                                                                                                     | Mitigation Measures and/or Safeguards                                                                                                                                                                                                                                   | Responsibilities       |                         |
|---------|------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-------------------------|
|         |                                                                                                                              |                                                                                                                                                                                                |                                                                                                                                                                                                                                                                         | Planning and Execution | Supervision/ Monitoring |
|         |                                                                                                                              |                                                                                                                                                                                                | GRM to deal with GBV related issues.                                                                                                                                                                                                                                    |                        |                         |
| 4       | Removal of Terrestrial Weed: <i>Prosopis juliflora</i> and planting the native species<br><br>ESS 2, ESS 6                   | Likely injury by thorns present in the <i>Prosopis juliflora</i> to the persons involved in removing and transportation. OHS and GBV issues. Also, may temporarily affect the sheltering birds | The removed shrubs and trees should be disposed of at stipulated locations adhering to regulations and not in any open land to prevent re-growth<br>Necessary protective gear to avoid injury while removing and transportation<br>GRM to deal with GBV related issues. | Contractor             | CAPML                   |
| 5       | Installation of a Floating Bar screen to filter floating inorganic materials like plastic papers, bottles etc.<br>ESS2, ESS3 | Possible infection to humans involved in removal as they may contain harmful bacteria (OHS)                                                                                                    | The removed plastic materials should be disposed of as per the TNPCB prescribed norms without causing solid waste pollution in another area. In case of use of any labour for this activity, suitable protective gear should                                            | Contractor             | CAPML                   |

| Sr. No.  | Activity and Environmental aspects                                                                                                                                                                                                                                                                                                                                                                                                                         | Potential Environmental and Social impacts                                                | Mitigation Measures and/or Safeguards                                                                          | Responsibilities       |                         |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|------------------------|-------------------------|
|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                           |                                                                                                                | Planning and Execution | Supervision/ Monitoring |
|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                           | be provided to avoid human contact                                                                             |                        |                         |
| <b>B</b> | <b>Construction Stage</b>                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                           |                                                                                                                |                        |                         |
| 6        | Construction of Sludge stabilization ponds and creation of constructed wetlands: To establish Bio-Remediation using plant species, Bio pits will be dug out and a concrete curb wall will be constructed to avoid soil erosion in those pits. The pits will be interconnected with pipes. 5 bio pits will be created, and a dosage of microorganisms will be added to the bio pits periodically to degrade sludge and reduce the bad odour.<br>ESS 2, ESS4 | Likely injury during construction and OHS issues to the labour involved                   | Necessary precautionary measures and care to avoid injuries                                                    | Contractor             | CAPML                   |
| 7        | Construction of small bridges to ensure free flow of water and desilting of minor waterways. Solid waste generation due to spillage of construction materials<br>ESS2, ESS3, ESS 6                                                                                                                                                                                                                                                                         | Likely injury during construction and temporary loss of soil fauna. Solid waste pollution | Necessary precautionary measures and care to avoid injuries<br>Solid waste to be disposed as designated places | Contractor             | CAPML                   |
| <b>C</b> | <b>Others</b>                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                           |                                                                                                                |                        |                         |
| 8        | Construction of Entrance Arch & Gates for better access<br>ESS2                                                                                                                                                                                                                                                                                                                                                                                            | Likely injury during construction                                                         | The safety of labourers should be ensured                                                                      | Contractor             | CAPML                   |

| Sr. No. | Activity and Environmental aspects | Potential Environmental and Social impacts                                                                                                                | Mitigation Measures and/or Safeguards                                                                                                                                                                                      | Responsibilities       |                         |
|---------|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-------------------------|
|         |                                    |                                                                                                                                                           |                                                                                                                                                                                                                            | Planning and Execution | Supervision/ Monitoring |
| 9       | Health and hygiene<br><br>ESS 2    | Environmental contamination in the absence of proper sanitation facilities at the site. Hardship to workers in case of lack of drinking water supply etc. | Proper sanitation facilities should be provided at working sites. Health and safety of workers esp. for the trained women in terms of shed, potable water, and other basic facilities as per BOCW Act 2006 to be provided. | Contractor             | CAPML                   |

## 2.2. E&S Mitigation and Management Plan – Action Responsibility Matrix

The project implementing agency is the Conservation Authority of Pallikaranai Marshland. The authority will engage Contractors to implement the activities under Protection and Consolidation and Eco-Restoration and Conservation.

### Contractor/s

| Activity                                                                                                                       | Reference action/document                                                  | Frequency                                        |
|--------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|--------------------------------------------------|
| Training and awareness of labour on Operational Health and Safety and instructions to prevent accidents, infections and GBV    | Date of training, a document containing contents on the training programme | Before the start of work and every 2 months      |
| Compliance with labour laws                                                                                                    | Copy of Labour license, ESI, PF                                            | -                                                |
| Availability of PPEs like helmets and foot wear                                                                                | List of PPEs – number of each type                                         | Before the start of work                         |
| Training of workers on Emergency Response in case of accidents                                                                 | Training records                                                           | Before the commencement of work                  |
| Identification of a designated place for dumping debris, weeds, cut wood etc., or a vendor to remove solid waste from the site | Name of the vendor and license                                             | Before the start of work                         |
| Submission of Quarterly Progress Report                                                                                        |                                                                            | Quarterly from the date of the start of the work |

### By the Conservation Authority of Pallikaranai Marshland, Forest Department

| Specific Action/Preparation requirements                                                                                            | Timeline/Frequency                                             |
|-------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|
| Ensuring drinking water and restrooms for labour                                                                                    | Before the start of work                                       |
| Identification of GBV hotspots                                                                                                      | Before the start of work                                       |
| Clearance of solid wastes, weeds, removed Prosopis etc., within a short stipulated time                                             | Day to day inspection when work is in progress                 |
| Ensuring safer disposal of toxic contaminants arising from debris, silt and weeds as per the procedures described for such disposal | Day to day inspection during removal of weeds, silt, etc.      |
| Monitoring of noise levels                                                                                                          | The entire course of work – esp. during operation of machinery |
| Identification of labour personal disposal location                                                                                 | Before the start of work                                       |

| Specific Action/Preparation requirements                                                                                                 | Timeline/Frequency                                  |
|------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|
| Establishing GRM and its awareness – with signage with the name of the officer responsible for reporting and checking its effectiveness  | Before the start of work and review every month     |
| Checking compliance with labour laws by the contractor                                                                                   | Before the start of work, thereafter every 3 months |
| Ensuring the Quality of protective equipment like helmets                                                                                | Before the start of work, thereafter every 3 months |
| Submission of Quarterly Progress Report to the TN-SHORE project authorities through the Forest Department during the construction period | Quarterly                                           |

### 3.0. Implementation Arrangements and ESMP Budget

#### 3.1. Implementation and Supervision Arrangements

The Conservation Authority of Pallikaranai Marshland (CAPML) is the agency to implement the project along with the Contractors engaged for the activities planned under the two components mentioned earlier. The authority needs to ensure compliance with pollution management norms, provide all PPEs required for labour, adoption of Labour Law and GRM procedures while implementing the ESMP. Details of the budget allocated for the proposed activities are:

| SI No | Component                      | Activity                                                                                                                                                  | Rs.in Laksh |     |         |     |          |
|-------|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-----|---------|-----|----------|
|       |                                |                                                                                                                                                           | Qty         |     | Rate    | Per | Amount   |
| 1     | Protection & Consolidation     | Activity 2.2.1: Removal of Impediments such as debris, solidwaste, etc                                                                                    | 6450        | M3  | 0.00288 | M3  | 18.58    |
| 2     |                                | Activity 2.3.1: Formation of bund along the boundary of the Marsh                                                                                         | 2500        | RM  | 0.10185 | Rm  | 254.63   |
| 3     |                                | Activity 2.3.2: Formation of walk pathusing natural hard granite stone flooring with kerb                                                                 | 2500        | RM  | 0.29850 | Rm  | 746.25   |
| 4     |                                | Activity 2.3.4: Small bridges across water ways in the Marshland and bridge for connecting the existing Eco-park and Proposed Wetland Conservation Centre | 3           | Nos | 100     | No  | 300.00   |
| 5     | Eco-Restoration & Conservation | Activity 3.1.1: Removal of debris anddesilting of Channels                                                                                                | 20000       | M3  | 0.00387 | M3  | 77.40    |
| 6     |                                | Activity 3.1.2: Desilting of existingCulverts                                                                                                             | 97000       | M3  | 0.00103 | M3  | 99.91    |
| 7     |                                | Activity 3.3.1: Removal of AquaticWeed : Water hyacinth                                                                                                   | 719400      | M2  | 0.00029 | M2  | 208.626  |
| 8     |                                | Activity 3.3.2: Removal of Terrestrial Weed: Prosopis juliflora                                                                                           | 688150      | M2  | 0.00009 | M2  | 61.93    |
|       |                                | Implementation of ESMP ( Lump sum) by contractor*                                                                                                         |             |     |         |     | 4.00     |
|       | Total Amount                   |                                                                                                                                                           |             |     |         |     | 1771.321 |

\* budget includes for labour training, Awareness,PPEs as recommended in ESMP of this component

In compliance with the framework provisions of Standard ESMP, which shall be implemented by the Contractors, will be included as part of Bids, and the Contractors upon being awarded the contract shall submit an ESMP with updated inputs on mitigation measures and safeguards and also using the present ESMP . The contractor shall include in the bid a budget to prepare the updated ESMP and the cost to implement the measures mentioned in the ESMP.

### **3.2. Reporting**

#### **a. Reporting by contractor and monitoring by CAPML**

The contractors shall prepare a quarterly progress report to comply with the provisions of the E&S Mitigation and Management Plan, ESMP and other related issues arising during construction. The contractors shall also specify any incidents of accidents, injuries and GBV related issues in the report and action taken to resolve and prevent such incidents

#### **b. Reporting by the CAPML**

The Implementing agency shall prepare for each site a report on the progress made during construction indicating compliance with the measures suggested in ESMP, and also accidents and incidents of GBV, and submit it to the TN SHORE project authorities through the Forest Department.

## Annexure 1

### ESMF: Potential E&S Risks and Impacts due to **Championing Pallikaranai: Advancing Wetland Conservation & Restoration** - Prevention & Consolidation and Eco-restoration and Conservation components

| Activity                                                                                             | Potential Risks and Impacts                                                                                                                                                 | Mitigation measures                                                                                                                                                                                                                                | Applicable ESSs            | Intensity of Impact (L/M/S/H) | Responsibilities     |                                                                                                     |
|------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|-------------------------------|----------------------|-----------------------------------------------------------------------------------------------------|
|                                                                                                      |                                                                                                                                                                             |                                                                                                                                                                                                                                                    |                            |                               | Planning / Execution | Supervision/ Monitoring                                                                             |
| A. Potential Environmental Risks and Impacts and Mitigation Measures                                 |                                                                                                                                                                             |                                                                                                                                                                                                                                                    |                            |                               |                      |                                                                                                     |
| Pre-Construction Stage                                                                               |                                                                                                                                                                             |                                                                                                                                                                                                                                                    |                            |                               |                      |                                                                                                     |
| Removal of debris from the wetland such as construction debris, solid waste, garbage, etc.           | <ul style="list-style-type: none"><li>Removed debris may contain toxic elements and bacteria which could affect the workers &amp; health safety of the community.</li></ul> | <ul style="list-style-type: none"><li>Proper training will be given to local women as empowerment/employment generation prior to activity with protection gears like gloves, shoes, etc.</li></ul>                                                 | ESS 1, ESS 2, ESS 4        | L                             | Contractor           | Conservation Authority of Pallikaranai Marshland (CAPML)/ Department of Forest, GoTN & SPMU, TNGCC. |
| Bunds formation and consolidation of bund around the Marshland boundary & native species plantations | <ul style="list-style-type: none"><li>Dust generation</li><li>Use of machineries in wetland</li></ul>                                                                       | <ul style="list-style-type: none"><li>Proper dust suppression measures like water sprinkling will be followed</li><li>Safety measures prescribed while operating machines should be followed to ensure that the wetland is not affected.</li></ul> | ESS 1, ESS 3, ESS 4, ESS 6 | L                             | Contractor           | Conservation Authority of Pallikaranai Marshland (CAPML)/ Department of Forest, GoTN & SPMU, TNGCC. |
| Clearing of blocks in the waterways that                                                             | <ul style="list-style-type: none"><li>De-silting of channels from 0.5 to 2.5m below</li></ul>                                                                               | <ul style="list-style-type: none"><li>Avoiding desilting during bird migrations</li></ul>                                                                                                                                                          | ESS 1, ESS 3, ESS 4, ESS 6 | S                             | Contractor           | Conservation Authority of                                                                           |

| Activity                                                                                       | Potential Risks and Impacts                                                                                                                                                                                                                                               | Mitigation measures                                                                                                                                                                                                                                                                                                                                            | Applicable ESSs            | Intensity of Impact (L/M/S/H) | Responsibilities     |                                                                                                     |
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|                                                                                                |                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                |                            |                               | Planning / Execution | Supervision/ Monitoring                                                                             |
| feed the marsh                                                                                 | <p>the Chart datum to facilitate free flow of water from the southern part of the 200-foot road to the northern part thereby affecting soil characteristics, flora &amp; fauna</p> <ul style="list-style-type: none"> <li>• Use of machineries</li> </ul>                 | <ul style="list-style-type: none"> <li>• Restricting the active working to day time only</li> <li>• By proper planning &amp; execution of the activity with supervision</li> <li>• Conservation plan for Flora/Fauna &amp; Wetland</li> <li>• Suitable site identification for disposal of desilted material</li> </ul>                                        |                            |                               |                      | Pallikaranai Marshland (CAPML)/ Department of Forest, GoTN & SPMU, TNGCC.                           |
| Removal of Eichhornia plants in the entry point of the channel by deploying floating machinery | <ul style="list-style-type: none"> <li>• Extraction of Eichhornia plant &amp; impacts on worker doing the activity</li> <li>• Chances of contamination at disposal site by chemicals absorbed by Eichhornia</li> <li>• Effect on wetland its flora &amp; fauna</li> </ul> | <ul style="list-style-type: none"> <li>• The removed Eichhornia plants will be disposed of safely without causing pollution in another area.</li> <li>• suitable protective gear should be provided to avoid human contact, as the bacteria present in the plant may pose health risks to the labourers</li> <li>• Safety measures through activity</li> </ul> | ESS 2, ESS 3, ESS 6        | L                             | Contractor           | Conservation Authority of Pallikaranai Marshland (CAPML)/ Department of Forest, GoTN & SPMU, TNGCC. |
| Removal of Aquatic & Terrestrial Weed and planting the native species                          | <ul style="list-style-type: none"> <li>• Likely injury by thorns to the persons involved in removing and transportation.</li> </ul>                                                                                                                                       | <ul style="list-style-type: none"> <li>• The removed shrubs and trees should be disposed of at stipulated locations adhering to regulations and not in any</li> </ul>                                                                                                                                                                                          | ESS 1, ESS 2, ESS 4, ESS 6 | L                             | Contractor           | Conservation Authority of Pallikaranai Marshland                                                    |

| Activity                                                                                                       | Potential Risks and Impacts                                                                                                                                                                  | Mitigation measures                                                                                                                                                                                                                                                                        | Applicable ESSs     | Intensity of Impact (L/M/S/H) | Responsibilities     |                                                                                                        |
|----------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------------|----------------------|--------------------------------------------------------------------------------------------------------|
|                                                                                                                |                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                            |                     |                               | Planning / Execution | Supervision/ Monitoring                                                                                |
|                                                                                                                | <ul style="list-style-type: none"> <li>Effect on wetland its flora &amp; fauna</li> </ul>                                                                                                    | <ul style="list-style-type: none"> <li>open land to prevent re-growth</li> <li>Necessary protective gear to avoid injury while removing and transportation</li> <li>By proper planning &amp; execution of the activity with supervision.</li> </ul>                                        |                     |                               |                      | (CAPML)/<br>Department of Forest, GoTN & SPMU, TNGCC.                                                  |
| Installation of a Floating Bar screen to filter floating inorganic materials like plastic papers, bottles etc. | <ul style="list-style-type: none"> <li>Improper planning &amp; installation issues and possible blockage of water flow</li> </ul>                                                            | <ul style="list-style-type: none"> <li>The removed plastic materials should be disposed of as per the TNPCB prescribed norms without causing solid waste pollution in another area.</li> <li>Regular supervision &amp; maintenance</li> </ul>                                              | ESS 3, ESS 4        | L                             | Contractor           | Conservation Authority of Pallikaranai Marshland (CAPML)/<br>Department of Forest, GoTN & SPMU, TNGCC. |
| Labour Management                                                                                              | <ul style="list-style-type: none"> <li>Since the proposed site is located within the wetland, labour camp cannot be created at site</li> <li>Non-disclosure of construction site.</li> </ul> | <ul style="list-style-type: none"> <li>The required labour will be sourced locally and the construction activity will be restricted to day hours after which the labour will exit the wetland</li> <li>Project Information Board with important phone numbers will be displayed</li> </ul> | ESS 1, ESS 2, ESS 6 | M                             | Contractor           | Conservation Authority of Pallikaranai Marshland (CAPML)/<br>Department of Forest, GoTN & SPMU, TNGCC. |

| Activity                                                     | Potential Risks and Impacts                                                                                                                                                                                                                                                                                                                                                                                                  | Mitigation measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Applicable ESSs            | Intensity of Impact (L/M/S/H) | Responsibilities     |                                                                                                     |
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|                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                            |                               | Planning / Execution | Supervision/ Monitoring                                                                             |
|                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                              | prominently at the subproject construction site.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                            |                               |                      |                                                                                                     |
| Procurement of Construction materials and its transportation | <ul style="list-style-type: none"> <li>Procurement of construction materials from illegal sources resulting legal action on subproject/contractor.</li> <li>Exhaust emissions and high noise generation from Other Construction Vehicles, Equipment and Machineries to be deployed at construction site.</li> <li>Exhaust emissions &amp; high noise may affect health of community and disrupt the biodiversity.</li> </ul> | <ul style="list-style-type: none"> <li>In the event of procuring, aggregate and sand from third party, the contractor shall ensure that these stone and sand quarries are legal and have valid clearances.</li> <li>No batching plant will be established within the wetland.</li> <li>All vehicles, equipment and machinery to be used for construction work will conform to the relevant Bureau of Indian Standard (BIS) norms/CPCB standards. The discharge standards promulgated under the Environment Protection Act, 1986 and Motor Vehicles Act, 2019 will be strictly adhered to.</li> <li>The contractor shall maintain records of Pollution Under Control (PUC) certificates for</li> </ul> | ESS 1, ESS 3, ESS 4, ESS 6 | M                             | Contractor           | Conservation Authority of Pallikaranai Marshland (CAPML)/ Department of Forest, GoTN & SPMU, TNGCC. |

| Activity                                                             | Potential Risks and Impacts                                                                                                                                         | Mitigation measures                                                                                                                                                                                                                                                                                               | Applicable ESSs     | Intensity of Impact (L/M/S/H) | Responsibilities     |                                                                                                     |
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|                                                                      |                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                   |                     |                               | Planning / Execution | Supervision/ Monitoring                                                                             |
|                                                                      |                                                                                                                                                                     | <p>all vehicles used during the contract period, which will be produced to PIU for verification whenever required.</p> <ul style="list-style-type: none"> <li>Special attention to be given not to cause any disturbance to the wetland and the surroundings of the construction site.</li> </ul>                 |                     |                               |                      |                                                                                                     |
| <b>B. Potential Social Risks and Impacts and Mitigation Measures</b> |                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                   |                     |                               |                      |                                                                                                     |
| <b>I. Pre-Construction Stage</b>                                     |                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                   |                     |                               |                      |                                                                                                     |
| Deployment of Labour                                                 | <ul style="list-style-type: none"> <li>Unrest in local community if work opportunities are not given to local people.</li> <li>Labour camp related risks</li> </ul> | <ul style="list-style-type: none"> <li>The contractor preferably will use unskilled/ semiskilled/ skilled labour from local area to give the maximum benefit to the local community.</li> <li>No labour camp will be setup inside the wetland. Hence, appropriate labour management shall be followed.</li> </ul> | ESS 1, ESS 2, ESS 6 | L                             | Contractor           | Conservation Authority of Pallikaranai Marshland (CAPML)/ Department of Forest, GoTN & SPMU, TNGCC. |

| Activity                                                                                 | Potential Risks and Impacts                                                                                                                                                                                                                                                                              | Mitigation measures                                                                                                                                                                                                                                                                                                                                                                     | Applicable ESSs             | Intensity of Impact (L/M/S/H) | Responsibilities     |                                                                                                     |
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|                                                                                          |                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                         |                             |                               | Planning / Execution | Supervision/ Monitoring                                                                             |
| Implementation and supervision of ESMP including occupational health and safety measures | <ul style="list-style-type: none"> <li>Lack of implementation and supervision of mitigation measures, ESMP including occupational health and safety measures causing pollution and environmental degradation and unsafe acts, unsafe conditions, accidents to the Biodiversity &amp; Wetland.</li> </ul> | <ul style="list-style-type: none"> <li>The contractor shall appoint qualified and experienced Environment &amp; Safety Officer (ESO), who will dedicatedly work and ensure implementation of EMP including occupational health and safety issues at the camp, plant and construction work sites and ensure that the wetland and its ecosystem is not affected in any manner.</li> </ul> | ESS 1, ESS 2, ESS 3 , ESS 6 | M                             | Contractor           | Conservation Authority of Pallikaranai Marshland (CAPML)/ Department of Forest, GoTN & SPMU, TNGCC. |
| Labour deployment                                                                        | <ul style="list-style-type: none"> <li></li> </ul>                                                                                                                                                                                                                                                       | <ul style="list-style-type: none"> <li>Labour licences, permits workman policies will be obtained.</li> <li>Labour Management Procedure (LMP) including OHS management plan will implemented.</li> <li>GBV Action Plan will be implemented.</li> <li>Grievance Redressal Mechanism (GRM) will be prepared and followed.</li> </ul>                                                      | ESS 1, ESS 2, ESS 4         | M                             | Contractor           | Conservation Authority of Pallikaranai Marshland (CAPML)/ Department of Forest, GoTN & SPMU, TNGCC. |

**Technical details on the proposed activities**

**1. Protection and Consolidation**

**Activity 1.1 Systematic Surveys & Demarcation of Boundaries Activities:**

Survey of Pallikaranai Marshland: On site assessment of the boundaries, both terrestrial and aquatic to identify and demarcate boundaries of Pallikaranai Marsh without conflict.

- a. Survey of Pallikaranai Marshland
- b. Drone Mapping for clear boundary Demarcation
- c. Installation of Boundary stone

**Activity 1.2. Removal of Impediments Activities:**

Identification and removal of impediments in the marsh which impact its functioning such as construction debris, solid waste, garbage, etc.

- a. Removal of Impediments such as debris, Solid wastes etc.,

**Activity 1.3. Enhanced Access to Marshland Activities:**

Bunds formation through removed Silt/Sand and consolidation of bund across the Marshland boundary by native species plantations: The Marsh has heavy deposits of debris from building materials in the adjoining urban areas. This has reduced the water holding capacity and affected the habitats of the birds. Hence the debris removed from this Marsh will be deposited on the boundary and new bunds will be formed which will protect the marsh land from further encroachments. This bund will be consolidated by providing rough stone dry packing.

- a. Formation of bund along the boundary of the Marsh
- b. Formation of walk path using natural hard granite stone flooring with kerb
- c. Consolidation of bund by raising plantations on either side of walk path with taller size indigenous tree species.
- d. Small bridges across water ways in the Marshland and bridge for connecting existing Eco-park and Proposed Wetland Conservation Centre.
- e. Entrance Arch & Gates for better access
- f.

## **Activity 1.4 Protection and Conservation of Marshland and Biodiversity**

Engaging watchers for the protection of Marshland and Biodiversity: The watchers must be engaged for the protection of the marshland from activities such as dumping of garbage, letting out of sewage, poaching, fishing, fire, encroachment, etc., from the adjacent habitats. It is proposed to engage the 10 Nos. of watchers for protection works.

## **2. Eco-Restoration & Conservation**

### **2.1. Structural Measures**

In order to maintain the brackishness and to maintain the water holding capacity, the hydrodynamic studies based on the tidal boundary and the water depth condition of the existing marshland which suffers from extensive sedimentation, debris, encroachment and sewerage disposal are considered. The study revealed that the hydrodynamic condition and pattern differ in different locations.

#### **a. Removal of debris and clearing of blocks in the waterways that feed the marsh:**

For this activity it is proposed to divide the Marshland into two zones.

Zone-I indicates the north side of the 200 feet road which is to be subjected to debris removal and clearing of blocks in the waterways to maintain a level of (-0.5m w.r.t Chart. Datum-CD). The encroachment area in the wet land which is to be restored is indicated in Fig 12 (highlighted in red).

Zone II indicates the south side of the 200 feet road which is to be subjected to debris removal and clearing of blocks in the waterways to maintain a level of -2.5 m w.r.t C.D. from canal to +0.5m w.r.t C.D. at the culverts of 200 feet road with a gradual slope. A prominent shoal near the mouth of the wet land which is to be restored is indicated in Fig 12 (highlighted in red).

The canal depth should be maintained to -2.5m w.r.t C.D with the existing prominent shoal.

#### **b. Removal of debris in existing Culverts:**

Culverts are essential along the highways and roads passing nearby or through the wetland, and the trails and pathways in the wetland. Culverts connect the protected area with the remaining part of the wetland and other water bodies. 6 Culverts widening to be undertaken along with the de-silting of channels as per the zone-wise plan.

## **2.2. Bioremediation Measures**

### **a. Phytoremediation Activities:**

Heavy metals are one of the most toxic pollutants hazardous to the living things. Lead is one of the most toxic pollutants which disrupt the food chain. The existing purification method for removal of contaminants from the wastewater is not only costly but causes negative impact to the ecosystem. Bioremediation is an eco- friendly technology which is ecologically viable. This technology involves efficient use of aquatic plants to remove the toxic heavy metals from the wastewater. The common heavy metals are Pb, Zn, Cd, Cu, Ni and Mn.

Bioremediation is the use of living organisms to clean up environmental contaminants. Bacteria, fungi, and plants have all been used successfully for different types of bioremediations. When there is a use of plants it is called Phytoremediation. Stage wise process to establish bioremediation process units:

i. **Removal of Eichhornia:** To establish the Bio-Remediation Process units, the Eichhornia plants in the entry point of the channel must be removed by deploying floating machinery

#### **ii. Hydrology and Water tests:**

Study on water Quality aspects for the Marshland: - A study on water quality aspects for the marshland was conducted in 2010. It is imperative to carry out a fresh comprehensive study of water quality in Pallikaranai Marshland bimonthly by assessing the parameters to assess the change which will assist in future management interaction. This comprehensive study to be conducted for a year will involve collection of samples bimonthly for a year and will require logistics and facilities like hiring of boats as many sample points are inaccessible by road. Assessment of influent water volume in the culvert must be taken and the water samples may be collected from 25 sample points every quarter for lab testing to ascertain the quality of the water before and after treatment.

iii) **Diverting the inflow water:** All the proposed channels have an average water inflow rate of more than 5,00,000 ltr per 24 hours. This continuous inflow of water must be stopped by stacking sandbags on the channels and be diverted temporarily and the water logged in the proposed site will be evacuated by using a motor.

iv **Construction of Sludge stabilization ponds and creation of constructed wetlands:** To establish Bio-Remediation Process units Biopits must be dug out and a concrete curb wall must be constructed to avoid soil erosion in that pits and the pits will be interconnected with pipes. 5 bio pits will be created, and dosage of microorganisms will be added to the bio pits periodically to degrade sludge and reduce the bad odor.

- **Floating Bar screen:** Floating Bar screen will be installed to filter floating inorganic

materials like plastic papers, bottles, etc.

- **Reed bed tanks with media:** Reed bed must be constructed and *Canna indica* plant (kalvazhai plant) connects the clarified water to reed bed (Fig.2).
- **Pond bioremediation:** The pond must be bio-remediated to maintain a Dissolved Oxygen level from 7 to 8 ppm-better quality of water and odor will be arrested instantly.

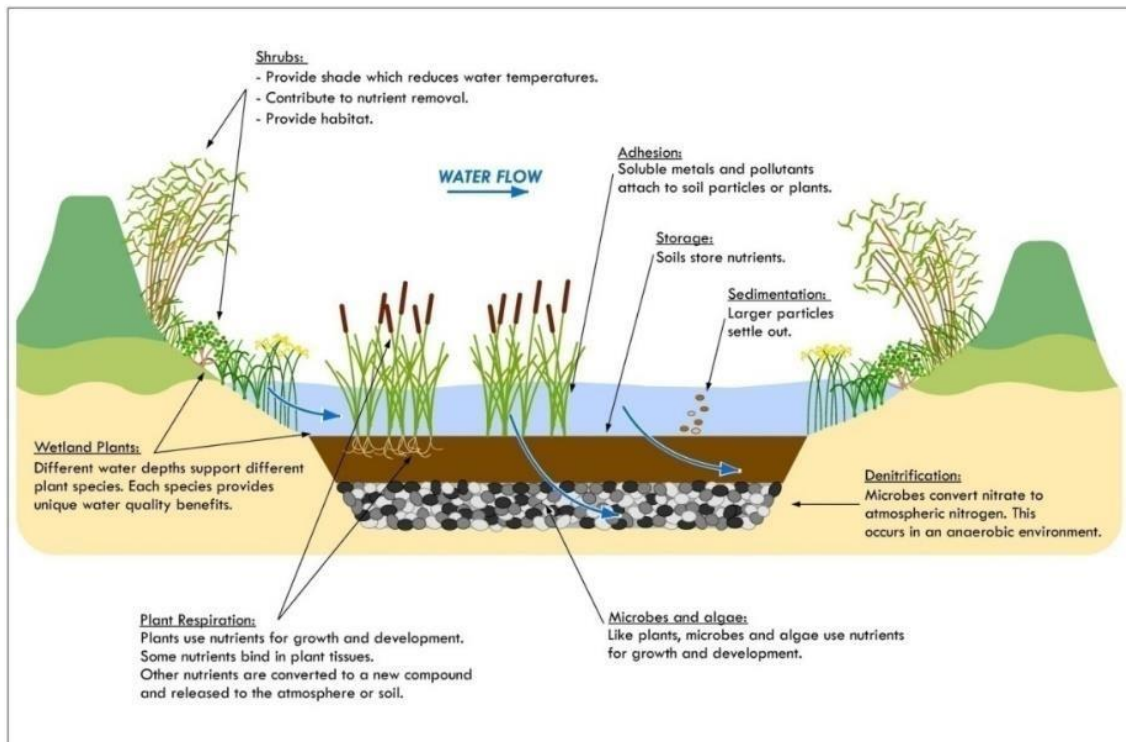


Figure 2: Phytoremediation Process

#### Advantages of Bio-Remediation process:

- Improves water clarity
- Improves dissolved oxygen levels
- Reduces Sludge
- Improves Eco System
- Safe and Environment friendly

### 2.3. Removal of Aquatic & Terrestrial Weeds Activities:Activity

#### a. Removal of Aquatic Weed : Water hyacinth

Aquatic weed (water Hyacinth) removal is proposed as a routine activity, which needs to be undertaken every year. There are several popular control mechanisms for preventing the spread of, or eradication of, water hyacinth. Physical control, using manual extraction methods, is used widely and is a low budget method. Therefore, this method is suggested, to eradicate the water, Hyacinth.

#### **b. Removal of Terrestrial Weed: *Prosopis juliflora***

The activity includes clearing and uprooting of *Prosopis* and *Parthenium* vegetation across the project area. Those areas should be replaced with native tree species, suggested as part of the Green Belt activity 3.4.1 Supplying and planting healthy tree saplings, one year old, height not less than 1.75 m, at a spacing 3m x 3m for trees, and 1.5m x 1.5m for shrubs creepers (1m height/length) in, bunds, including monitoring (watering, mulching, pruning and de-weeding) and replacement of mortalities until the project completion.

### **2.4. Establishing Green Belt Activities:**

#### **a. Native species plantations on bunds & other strategic areas:**

On bunds and other strategic areas of marshland including along the trails / path made along the boundary (Fig 3). The species will be selected based on their dust and sound absorbing capacity and water tolerance. Bird attracting species need to be given preference for plantation. It is also important to plant butterfly attracting species of plants especially herbs.

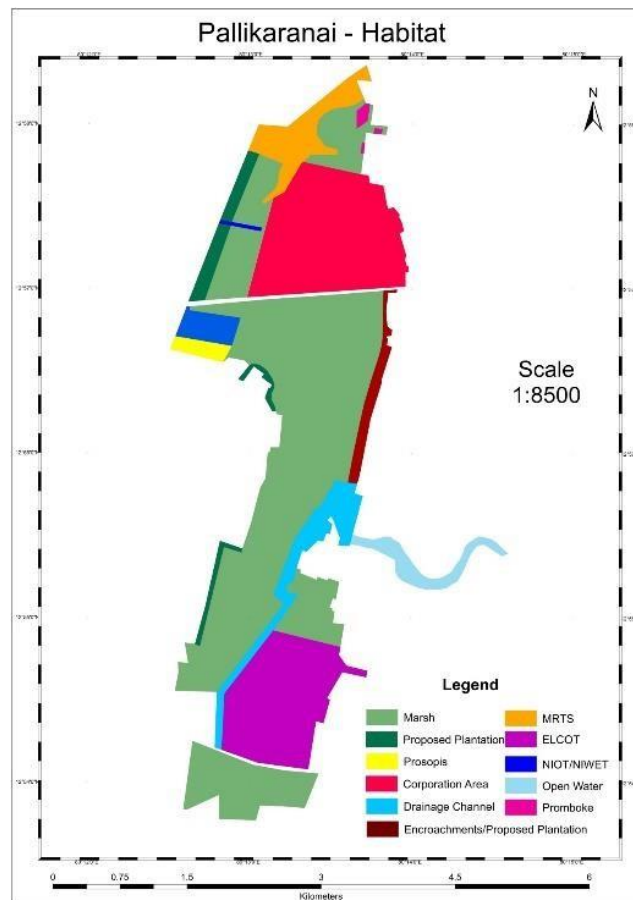
### **2.5. Habitat Enrichment**

#### **a. Habitat Restoration and Enrichment for Wetland Fauna:**

Habitat enrichment through the creation of a diversity of habitats such as deep water, mudflats, and elevated earth banks. Following are the habitat types utilized by waterbird species that need to be protected

- Islands are used as breeding sites for several species that nest on the ground. Waders and terns also commonly use these areas as roosts for 'loafing'.
- Mudflats and shallow water that are rich feeding areas for a range of migratory waders such as the Stint, Curlew Sandpiper, etc. who probe the water and flats for tiny animals. Larger water birds with long legs and bills such as the egret, pelican, spoonbill, avocet, stilt, heron, curlew, and oystercatcher can be found in the shallows probing, spearing, sieving, and scooping for food.
- Emergent sedges, rushes and grassy bank areas attract many wading birds. Vegetation of this type provides cover for waterbirds and nesting sites. Crakes, rails and various songbirds are attracted to the rushes in freshwater swamps near estuaries. Ducks, moorhens and coots use open water for loafing and feed in emergent vegetation and grassy bank areas. Ibis, herons and swamp-hens are also attracted to fringing vegetation as feeding areas.

- Deep open water attracts diving waterbirds such as swans, coots, cormorants, grebes and some ducks which dive for bottom-dwelling animals or aquatic vegetation. Other waterbirds such as terns feed on fish close to the surface.



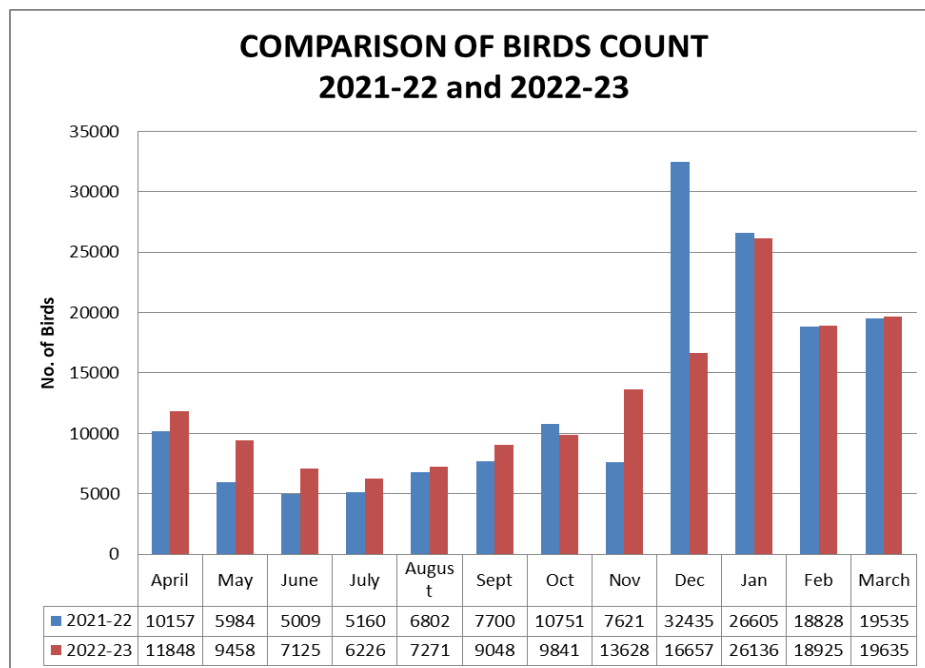
**Figure 3: Proposed Plantations Map in the Marshland**

## **b. Monitoring the Bird Diversity :**

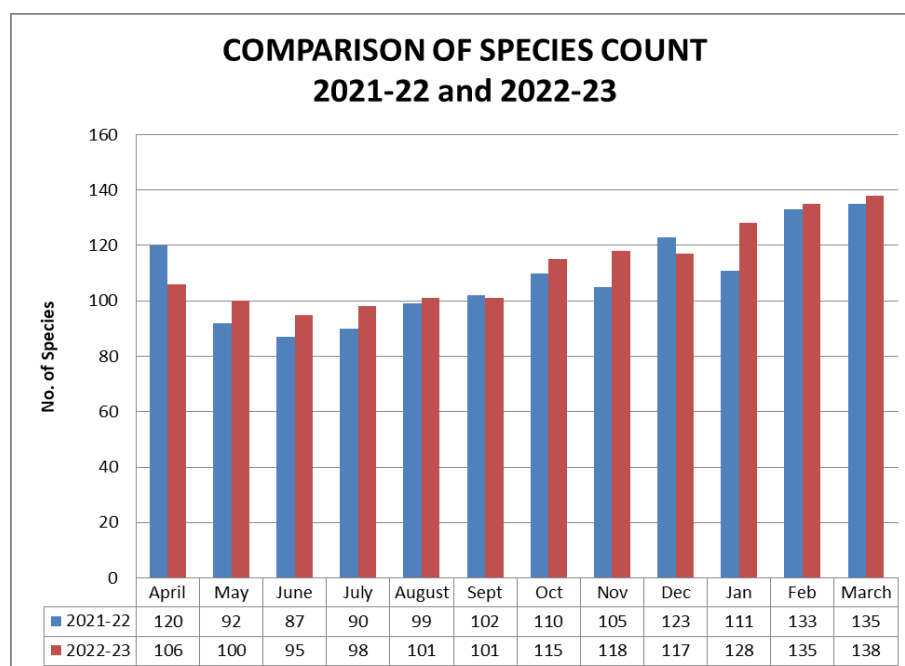
### **i. Bird Census**

The population of the birds in particular area mainly depends upon the eco- system that prevails in that particular area. If the eco-system is good enough, the bird population will be good. Hence, birds are good indicators of health of wetland ecosystem. Pallikaranai Marshland attracts migratory / aquatic / terrestrial birds. Bird census work has been conducted every month to get estimation of number of different species of birds visiting Pallikaranai Marsh Land. The Nature Trust, Chennai, NGO has been entrusted with work of carrying out bird census. There has been a steady increase in the diversity of birds and their populations in the past 10 years.

A Chart showing the comparison of Birds Count, Species for the year 2021-22 and 2022-23 is depicted in the figures 4 and 5 below.



**Fig.4. Comparison of bird counts in the years 2021-22 and 2022-23**



**Fig.5. Comparison of bird species counts in the years 2021-22 and 2022-23**

## ii. Refuge for Migratory Birds:

Pallikaranai wetland not only supports the indigenous local species but also the migratory birds. This wet land is an important feeding, breeding ground for birds and it provides a stopping place for migrating water birds. Proper scientific management of this wet land will attract more migratory birds in the future.

**3. Key facts about the sites based on the ecological factors:**

4. Perumbakkam hosts fresh water seeking ducks like the comb duck and Eurasian Wigeon.
5. Karapakkam where the Okkiyammaduvu connects hosts the highest number of species.

Ambedkar Nagar Phase I and II form the core of the Pallikaranai Marsh Lands. It has a mix of grassy plains and Typha grass. The Ruddy Shelduck was sighted in Pallikaranai Marsh Lands twice in this area.

Population trends based on the last three year data shows stable bird population in the mid or peak of the migration season. The December-January month's data for the last three years shows the densest population at the Pallikaranai Marsh Lands. Raptors are the good indicators of the eco-system. Raptors are the predatory birds. Increase in raptors shows the abundance in prey birds. In 2021-22, about 14 Raptors were documented in which 5 are resident raptors and 9 were winter visitor raptors

